APPENDIX A

Discrete Math Grade Level Strands

Network and Paths

Elementary Strand	Middle Strand	High School Strand (Concepts of geometry)
-Finding a path between two points on a network or grid	-Finding paths in a network or grid -Tree graphs	-Circuits -Networks and paths -Map coloring -Tree graphs

Counting

Elementary Strand	Middle Strand	High School Strand
-Sorting by attributes -Venn diagrams -Finding the number of arrangements where order makes matters or order does not matter -Geometric and arithmetic patterns	-Geometric and arithmetic patterns -Tree and Venn diagrams -Combinations and Permutations -Probability -Pascal's triangle	-Counting techniques such as combinations, permutations, and Pascal's triangle -Probability -Recursion including arithmetic and geometric

Fair Division

Elementary Strand	Middle Strand	High School Strand (Whole-to-Part)
-Fairly dividing an item or items among students	-Fair division of an item or items	-Fair division such as fairly dividing an estate -Apportionment such as apportioning members of the House of Representatives among states

Logic and Reasoning

Elementary Strand	Middle Strand	High School Strand (Cause and Effect)
-Deductive reasoning -Inductive reasoning	-Deductive reasoning including if-then statements -Tree and Venn diagrams	-Logic such as truth tables and Venn diagrams -Game theory which includes strategies -Election theory which includes the process of turning individual preferences into a single group decision

Matrices

Elementary Strand	Middle Strand	High School Strand
-Organizing information into table form	-Using matrices to organize date -Adding and subtracting matrices -Use of spreadsheets	For all students- -Use addition, subtraction, and multiplication to matrices to solve problems For students of upper level courses— -Use matrices to solve systems of equations

APPENDIX B

Appendix A

Some Common Errors and Notes from MAP Scorers on Ways to Improve Student Work

Issues around Student Work

1. When asked to "explain, defend, or show your work" students must demonstrate a clear understanding of the processes used. Responses should include appropriate terminology, clearly articulated sentences, and correct mathematical expressions.

2. Preparation for such written explanations must be provided on a regular basis in classroom instruction.

3. Performance events are scored holistically. Students need to demonstrate as much knowledge as possible even though they may not be able to complete the entire problem.

4. Students need to show work in a clear and organized manner. All work should be written with a #2 pencil so that all writing can be easily read and void of smudge marks. Work should not be shown on the edges of the page.

5. When asked for a variety of responses, students must clearly match responses with corresponding prompts.

6. If multiple solutions are shown, the student must identify the one that is appropriate for the given prompt.

7. When asked to show work, students that show only an answer will be given at most only partial credit for the problem even though the answer may be correct.

8. If a students crosses out work, that work is not considered in evaluating the problem.

9. When asked for such organizing tools as tree diagrams, Venn diagrams, tables, etc., students must provide a complete product showing all processes that are being addressed.

10. Students must be able to use appropriate mathematics terminology in reading and responding to problems. For example: In number theory concepts, such terms as prime, multiples, factors should be utilized.

Issues around Mathematical Content

1. If a problem asks for a solution written in dollars or cents, it is important that appropriate notation be given. For example 15 cents is written 15 ¢ not .15 ¢.

2. It is critical that students have a conceptual understanding of mathematics and not simply an understanding of standard algorithms. Examples (a.) Students should have a clear understanding of the concept of area not just use of the formula A= L x W when addressing areas of rectangles (b.) Students should be able to demonstrate pictorially the conceptual understanding of ½ ÷ ¼.

3. When elementary students are asked to fit and trace pattern blocks within a given figure, it is important that the student clearly traces the complete pattern block.

4. At the elementary, students should be able to read dial and digital clocks and utilize that information to determine elapsed time for given events.

5. Students should be able to solve multi-step problems in a variety of ways and to explain the processes that they used. Explanations can include written sentences, charts, picture, or mathematical expressions in conveying thought processes.

6. When asked to provide all combinations of a set, students should show all possibilities - not a partial set.

7. Students should be able to convert from one unit of measurement to another. Example: 3 feet = _____ in.; 2hrs. = ____min.; 4m. = ____ cm.

8. Students should be familiar with ways to organize, display and analyze data through the use of charts, graphs, Venn diagrams, and other organizational tools

9. Students should recognize geometric properties of congruence and similarity, and apply transformations that modify the position, size, and shape of geometric figures.

10. When comparing fractions, students need to have a conceptual understanding of part-to-whole relationships. Students should be able to subdivide the same unit into different fractional parts and determine appropriate comparisons.

11. Students should have a good understanding of place value and demonstrate relative position on a number line.

12. Students must write mathematical expressions correctly. For example, students may write $23.00 – 25% instead of the correct expression $23.00 - .25(23.00) to indicate a decrease in costs.

13. Students are not given credit for answers with incorrect labels. If the appropriate solution is to determine a volume and square units are given then the solution is

incorrect. In addition, 16^2 in. is not equivalent to 16 $in.^2$ when expressing units of area.

14. Students should review their work and see if the solution that they obtained was reasonable.

15. Student generated graphs must contain axes labels, headers, and any necessary legends.

16. When dealing with rounding of money, always round up to the nearest cent.

17. When asked to provide all combinations of a set, students should show all possibilities not a partial set.

18. Students should know and identify characteristics of plane geometric figures. For example: All squares are rectangle. This is a true statement
All rectangles are squares. This is not a true statement.

19. Students should be able to organize, analyze, and interpret data. Students should represent data in appropriate graphs (circle, bar, line, etc.) or table formats.

20. When using formulas, students should state the formula being used and clearly identify the substitutions being made in the formula.

21. Students should be careful in writing mathematical expressions to reflect what was intended. Example: 4÷36 = 9 should not be written for 36÷4 = 9

22. Combined expressions that result from stringing together multiple processes are not acceptable. Example: The expression 14 x 2 = 28 + 5 = 33 is not a correct mathematical expression.

23. Students should utilize and determine appropriate use of manipulatives in understanding mathematical concepts.

24. Students should use manipulatives to construct figures and diagrams that are as accurate as possible. For example: when asked to construct a circle graph, students should use a protractor not simply a free-hand drawing.

25. When graphing coordinates, students must be as precise as possible in plotting and labeling appropriate points.

26. When students are asked to solve algebraically, appropriate equations must be identified along with the work for solving the equations.